Q-dextran

CAS nr: N/A

Chemical name: 2-hydroxypropyl-trimethylammonium-dextran chloride

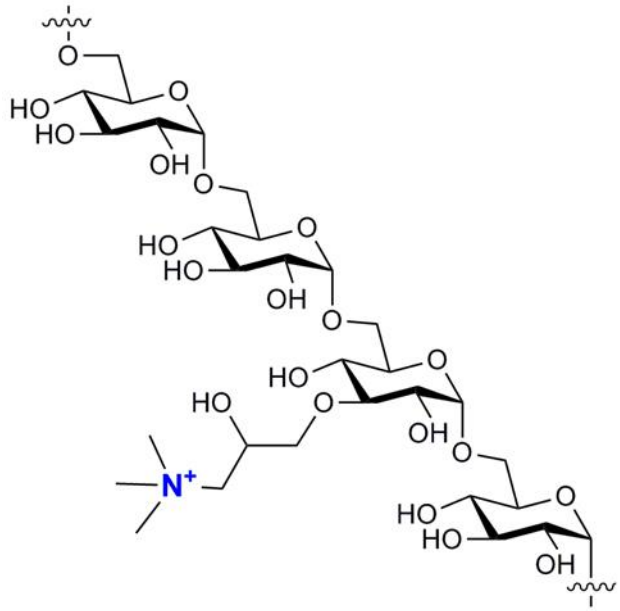

Fig. 1. Structure of fragment of Q-dextran. Q-dextrans contain only quaternary amine groups. These derivatives are very soluble in water and electrolyte solutions and are supplied as white powders.

Synthesis and structure

Q-dextrans are synthesised by reacting dextran fractions with 2,3-epoxypropyltrimethylammonium chloride 1–3. After purification, the products are controlled for Mean molecular weight (Mw, Mn), solubility, degree of substitution, and loss on drying. A specification may be obtained on request.

The products are designated by the approximate molecular weights of the dextran fractions used. Thus, for example, the product Q-dextran 70 has a molecular weight (Mw) of approx. 70 000. The actual molecular weight is determined by gel permeation chromatography (GPC). This value is supplied with the Certificate of Analysis. The differences between the Mw values of the starting dextran fraction and the final product depend on changes in the hydrodynamic volume of the molecules after substitution. The dextran used is from Leuconostoc mesenteroides B-512F which is essentially a linear α-(1-6)-linked glucose chain with however a low percentage (2-5%) of α-(1-3) branches distributed along the chain4. The dextran fractions used are from weight average molecular weights (Mw) of 4000 to 2000000 and are carefully controlled by GPC, absorbance, nitrogen content, pH, specific optical rotation and loss on drying.

Physical and chemical properties

These derivatives are very soluble in water and electrolyte solutions and are supplied as white powders. Q-dextrans contain only quaternary amine groups (see Fig.1). Unlike DEAE-dextrans, Q-dextrans will be positively charged over the normal range of use for dextrans (pH 4-10). The nitrogen content is approx. 2% (by elemental analysis) which corresponds to approximately one quaternary ammonium group for every four glucose units. It can be inferred from the molecular weight determinations (GPC), that the hydrodynamic volumes of Q-dextrans do not differ greatly from dextran itself. These products will have a much stronger net charge than corresponding DEAE-dextrans and thus give enhanced responses in systems where this effect is important5,6. The product has a pronounced cationic character by virtue of quaternary ammonium substituents and will exhibit affinity to polyanionic surfaces or molecules5,6. Q-dextrans are insoluble in most organic solvents, for example, ethanol, methanol, acetone, chloroform, ethyl acetate, and diethyl ether. The solution properties of cationic polymers have been widely studied, mostly by viscosimetry – a few examples are listed below5,6.

Stability

No formal stability studies on Q-dextrans have been reported. However the stability of DEAE-dextran is well-documented and since this closely resembles Q-dextran, we can presume that its quality and efficacy will be maintained for more than three years when stored at room temperature. It is recommended that the products are stored in air-tight containers in the dark.

Applications

Polycationic polysaccharides have been found to induce many interesting effects in biological systems presumably due to their cationic character and interactions with tissue and cell surfaces, which generally possess an overall negative charge. A random selection of references on various fields of application for polycationic dextrans is presented below.

Enhanced uptake by cells (transfection)

Many reports testify to the enhanced uptake of viral nucleic acids by cells in the presence of DEAE-dextran without detrimental effects on the cells7–9. Only at higher concentrations may such effects be apparent.

Adjuvant in vaccines

There are numerous reports on the efficacy of cationic-dextran in veterinary vaccine production in lambs, calves and piglets 10–12.

Agent for gene therapy

Numerous reports described potential applications of cationic-dextran for gene therapy 13.

Stabilizer for protein storage

DEAE-dextran has been shown to stabilize lyophilized proteins (e.g. enzymes) and also protein solutions. Further improvements may be achieved by using a combination of DEAE-dextran and a polyalcohol 14–17.

Agent for drug delivery

The electrostatic binding properties of cationic-dextran to polyanions is well established and has been used to present drugs and similar agents in a form that mediates the uptake of the agent in vivo 18–20. Recent studies penetrate the factors influencing complex formation and properties of the complexes21,22.

Flocculating agent

Many cationic polysaccharides showed high flocculating efficiency when used at optimal flocculant doses. The charge density of the polycations determines the efficacy for reaching the maximum degree of clarity23.

Bile acid sequestrant

The binding of various bile acids to dextran gels with pendant quaternary ammonium substituents was studied. The binding constants were found to be more than 20 times higher than for other commercial resins 24.

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